

**STAGGERED ROWS IN A CT OR SERPENTINE FIN  
CORE WITH A ROUND TUBE TO HEADER JOINT**

**CROSS-REFERENCE TO RELATED APPLICATIONS**

This application claims the benefit of U.S. Provisional  
5 Application No. 60/392,955 filed June 28, 2002.

**FIELD OF THE INVENTION**

The present invention generally relates to, but is not  
limited to, radiators, shell and tube type heat exchangers,  
charge air coolers, oil coolers, and fuel coolers.

10 More particularly, the invention relates to the staggered  
rows in a CT or Serpentine fin core with a round tube to header  
joint applications. Even more particularly, the present  
invention relates to a method of at least one of increasing  
airflow around a plurality of tubes in a heat exchanger, and  
15 increasing the web in a header around such plurality of tubes.

**BACKGROUND OF THE INVENTION**

Current CT style radiators have a plurality of tubes that  
are arranged in an array that are perpendicular to each other.  
This array is not equally spaced about the centerline of the  
20 tube ends, and therefore results in having different spacing  
between the tube pitch, and row pitch. Each tube column starts  
at the same point with respect to the airflow, at the front of  
the core. (See Figure 1) The tube pitch, and the row pitch, is  
symmetrical, at 90-degrees about the centerline, for each row

and column. This alignment as shown in figure 1 reduces the airflow over each tube. Since the tube array is laid out as shown with minimal distance between the tube pitches this causes an increase in manufacturing cost due to the tight tolerance stack between the tangents of the tube ends.

#### **SUMMARY OF THE INVENTION**

The present invention provides a method of at least one of increasing airflow around a plurality of tubes in a heat exchanger, and increasing the web in a header around such plurality of tubes, wherein the method includes the steps of providing a predetermined plurality of tubes having a predetermined end configuration, and a header having a predetermined number of openings. The predetermined number of openings are configured in a predetermined staggered array corresponding to the predetermined plurality of tubes, disposed in a heat exchanger. Finally, the method secures an end of each predetermined plurality of tubes into the predetermined number of openings in such header.

## OBJECTS OF THE INVENTION

It is, therefore, a primary object of the present invention to provide staggered rows in a CT or Serpentine fin core with a round tube to header joint that increases airflow around a  
5 predetermined plurality of tubes.

Another object of this invention is to provide staggered rows in a CT or Serpentine fin core with a round tube to header joint which permit a reduction in tolerance between the column pitches to aid in manufacturing.

10 Another object of this invention is to provide staggered rows in a CT or Serpentine fin core with a round tube to header joint which increases the web between the tubes to aid in airflow around such tubes.

Yet another object of this invention is to provide  
15 staggered rows in a CT or Serpentine fin core with a round tube to header joint which improves heat exchanger lifecycle.

Yet another object of this invention is to provide staggered rows in a CT or Serpentine fin core with a round tube to header joint which enables additional tubes to be placed in  
20 the same amount of envelope space.

Still another object of this invention is to provide staggered rows in a CT or Serpentine fin core with a round tube to header joint which allows for smaller more compact heat exchanger designs.

In addition to the above-described objects and advantages of the staggered array of this invention, various other objects and advantages of the present invention will become more readily apparent to those persons who are skilled in the same and related arts from the following more detailed description of the invention, particularly, when such description is taken in conjunction with the attached drawing figures and the appended claims.

#### **DESCRIPTION OF THE DRAWING**

Figure 1 is a detailed view of the tube column layout for a prior art non-staggered array.

Figure 2 is a detailed view of the tube column layout for a staggered array according to the present invention.

#### **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT**

Prior to proceeding to a much more detailed description of the present invention, it should be noted that identical components which have identical functions have been identified with identical reference numerals throughout the several views illustrated in the drawing figures for the sake of clarity and understanding of the invention.

Referring initially to Figure 1, which illustrates the prior art or non-staggered array. Reference number 10 generally indicates a non-staggered array constructed according to the

prior art. The non-staggered array 10 generally includes a plurality of tubes 12.

Now reference is made more particularly to Figure 2, which illustrates a presently preferred arrangement of the invention. Reference number 20 generally indicates a staggered array constructed according to the invention. The method of at least one of increasing airflow 28 around a plurality of tubes 12 in a heat exchanger, and increasing the web material 18 in a header around such plurality of tubes 12 includes the steps of providing a predetermined plurality of tubes 12 having a predetermined end configuration. The steps further include providing a header having a predetermined number of openings 22, in a predetermined staggered array 20, corresponding to the predetermined plurality of tubes 12, disposed in such heat exchanger, and securing an end of each predetermined plurality of tubes 12 into the predetermined number of openings 22 in the header.

Forming the predetermined staggered array 20 includes the additional steps of identifying a direction of airflow 24. Upon determining the direction of airflow 24, determining at least one of a row pitch 14 and a tube pitch 16 of the predetermined number of openings, and aligning at least one of the row pitch 14 and the tube pitch 16 with respect to the direction of airflow 24. Forming the staggered array 20 further includes

arranging the predetermined plurality of tubes 12 such that the row pitch 14 and the tube pitch 16 are spaced substantially identical, at about 45-degree increments, allowing for an acceptable amount of web material 18 between the predetermined number of openings 22. The acceptable amount of web material 18 between the predetermined number of openings 22 allows for predetermined operations to secure the predetermined plurality of tubes 12 into the predetermined plurality of openings 22 in the header. Wherein the predetermined operations include at least one of mechanical bonding and non-mechanical bonding. The mechanical bonding may consist of at least one of rolling and machining, and the non-mechanical bonding may consist of at least one of welding, brazing, and adhesive.

The predetermined end configuration of the predetermined plurality of tubes 12 is generally oblong in shape. However, the predetermined plurality of tubes 12 may also be generally oblong in shape along substantially an entire length thereof. A predetermined plurality of tubes 12 is considered to be at least two tubes.

A configuration of the predetermined number of openings 22 is created substantially identical to the predetermined end configurations of the predetermined plurality of tubes 12 creating a fluid seal. Creating the fluid seal is accomplished by at least one of a mechanical bond and a non-mechanical bond.

Wherein the mechanical bond includes at least one of rolling and machining, and the non-mechanical bond includes at least one of welding, brazing, and adhesive.

While both the presently preferred and a number of  
5 alternative embodiments of the present invention have been described in detail above it should be understood that various other adaptations and modifications of the present invention can be envisioned by those persons who are skilled in the relevant art without departing from either the spirit of the invention or  
10 the scope of the appended claims.